**CARTILAGE LABORATORY DEMONSTRATIONS**

# HYALINE CARTILAGE CELL

### ELECTRON MICROGRAPH

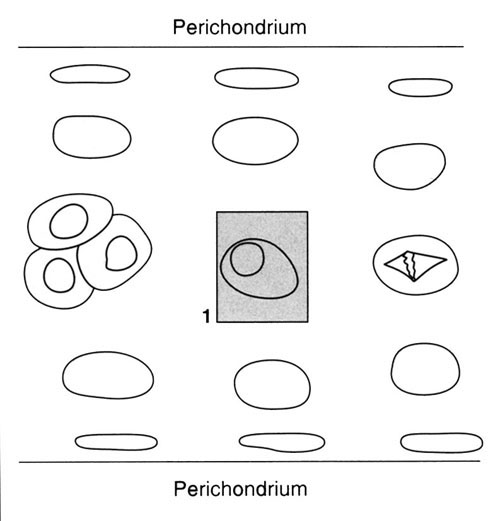
**Cartilage** is found in regions requiring support in conjunction with tensile strength (fibrocartilage), elasticity (elastic cartilage), and relative rigidity (hyaline cartilage). The functional characteristics of cartilage are carried out primarily by the fibers and proteoglycans of the extracellular matrix. The cells that synthesize these matrix components, **chondrocytes** (C, micrograph 1), have well-developed Golgi (G, micrograph 1) and rough endoplasmic reticulum (r, micropgraph 1) characteristic of protein-secreting cells.

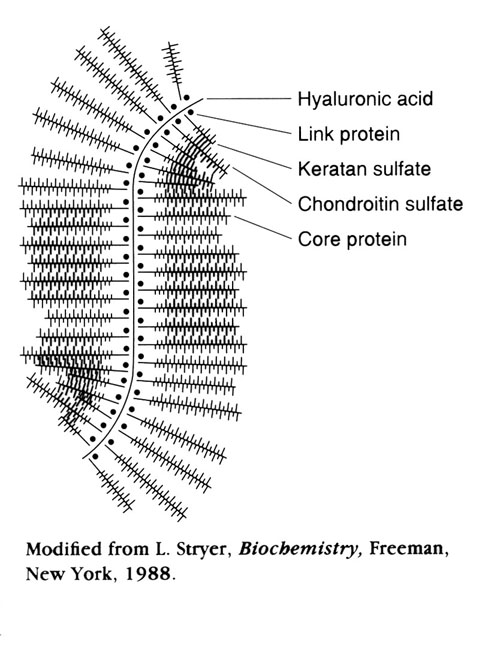
In both hyaline and elastic cartilage, chondrocytes develop from progenitor cells located in a surrounding connective tissue perichondrium (appositional growth). Even as differentiated cells surrounded by matrix, they retain their ability to undergo division (interstitial growth).

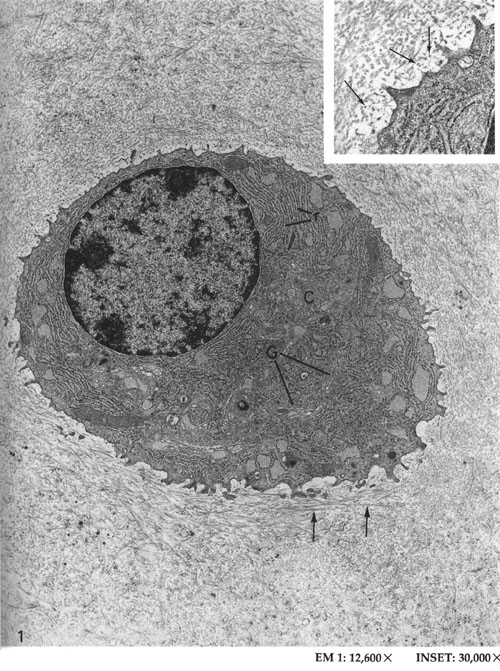
In routine electron micrographs, collagen (arrows, micrograph 1) is the only obvious component of the extracellular matrix. **Type II collagen**, is composed of thin (20 - 30 nm), faintly striated fibrils. The fibrils are not grouped together into fibers and therefore not typically observed in the light microscope.

**Proteoglycans**, an important component of all types of cartilage, are particularly prominent in hyaline cartilage (10% of the wet weight of the tissue). The **glycosaminoglycans** (GAGs) chondroitin sultate and keratan sulfate are covalently linked to a **protein core**, forming the basic proteoglycan unit. In cartilage, large numbers of these units form **agregates with hyaluronic acid** (an extremely large GAG) to form molecular structures 1200 nm long. The proteoglycans, like collagen, are synthesized at the plasma membrane, with the growing chain passing to the cell exterior. The final assembly into the aggregates of proteoglycans and hyaluronic acid occurs outside of the cell. Each hyaluronic acid molecule binds up to 100 proteoglycan molecules. Following isolation, hyaluronic aggregates appear as shown in the diagram; however, in routine electron micrographs they form 70-nm particles (arrows, inset).

The rigidity of cartilage is a result of swelling due to the high concentration of water associated with the anionic sites on the GAGs. The hydrated GAGs can be displaced, resulting in some deformability, but the large proteoglycan aggregates, "bound" between collagen fibrils, return to their original location, drawing water and providing resiliency. Bound water functions also as the medium for the transport of nutrients and wastes in this avascular tissue.







# FETAL THORACIC VERTEBRA - LOW POWER

Orientation of section through the bodies (**B**) of two vertebrae with intervening intervertebral disc which consists of the nucleus pulpus (**NP**) and the annulus fibrosis (**AF**). Hyaline cartilage (**HC**) is at the edge of the forming vertebral bodies. 25X



# INTERVERTEBRAL DISC - HIGH POWER

Fibrocartilage of the annulus fibrosus (**AF**) in the intervertebral disc is characterized by large roundish chondroytes with large amounts of collagen fibers between the cells. This gradually blends into dense regular connective tissue at the periphery of the disc (**\***) which is characterized by thin flattened fibrocytes between the parallel bundles of collagen fibers. 100X

